THE AGE OF THE RIFT VALLEY.

Note to the Editor.

Dear Sir,

In Professor Dr. Hans Reck's very interesting paper on "Pluvial Geology, Landscape and Man in the East African Rift Valley," published in the last issue of the Journal, there are expressions of opinion regarding the tectonic history of the East African Rift Valley as a whole, which other workers in the geological field have regarded as bearing application only to limited parts of it and only to the comparatively recent history of those parts. The views expressed seem to me, in fact, to indicate a high measure of reversion to those of Professor Suess as published in 1891. Dr. Reck does not give any evidence in his paper which appears to me to be at all adequate to establish the opinions which he expresses regarding the youthful origin of the Rift Valley as a whole, nor am I aware of any other publications which do so. Published views so divergent in principle from those generally held for many years seem to require publication of the full evidence on which such views are based and refutation of the cogency of previously accepted evidence, or deductions from it.

The impression one obtains from reading Dr. Reck's paper is that, except for some obscure faulting, the East African Rift Valley is geologically very young in origin. One gathers that, in Dr. Reck's opinion, its origin is Pleistocene, and indeed, by implication, Upper Pleistocene.

On page 92, Dr. Reck states that "Since the eminent work of Gregory, one has grown accustomed to look for the birthday of this gigantic rift in Tertiary times." He proceeds to indicate the opinion that recent work on prehistoric man in the Nakuru basin of the Rift Valley has given evidence of "a much younger origin for the colossal breakdown in the earth's crust of this country." Again on page 93 he says: "But if we bear in mind that all the rifting, as we find it expressed in the sharp forms of the present escarpments, took place within the time comprehended by man's development . . . . then we must conclude that the Rift formation is geologically not only a very young one but also that it took place with a quite unaccustomed speed of dislocation."

There are several other passages which seem strongly to indicate the opinion that the Rift Valley in East Africa is geologically very young, and at the bottom of page 92 one is led to understand that these views apply to the whole Rift Valley or series of Rift Valleys from the Taurus Mountains to the South of Portuguese East Africa.

One is tempted to think that during Dr. Reck's short visit to East Africa, when he visited the scene of his pre-war work in late German East Africa in the Balbal Depression, he failed to realise that much work had been done in connection with the stratigraphy of the volcanic sequence and the chemical, petrographic and genetic relationships of the divisions of that sequence to one another, together with the earth movements which occurred in the Rift Valley at various times.

The study of the stratigraphy of these divisions in relation to tectonic movements seems to show with a high degree of cogency of reasoning, that at least three periods of intensive volcanism occurred, and that after each period, faulting along Rift Valley planes, which mostly affected the products of the preceding volcanism, occurred. These deductions from the evidence necessarily predicate a long and varied existence of the Rift Valley, during which portions of it (in the volcanic area) were at times filled up, in whole or in part, with the products of volcanism, subsequently to suffer gravity faulting and disappearance below the lavas and tuffs of succeeding divisions of the volcanic sequence. It is not contended, of course, that volcanism ceased during periods of tectonic movements, nor that tectonic movements ceased during periods of volcanism, but that the evidence supports the view that intense volcanism and intense subsidence succeeded one another at intervals under regional crustal tension, roughly normal to the direction of the Eastern Rift Valley. It should perhaps be mentioned that this principle regarding the succession of volcanism and faulting is only intended to apply to the Volcanic Areas, and not to those parts, either in the Eastern or Western Rift Valley where volcanism has either not manifested itself or is strictly subordinate. In those parts, no doubt, the movements were of a different character. Nor is it suggested that the evidence rules out the original formation of either the Eastern or Western Rift Valley by pressure, engendering reversed faulting as a structural phenomenon which has been so ably advocated by Wayland.

One feels, however, that before the " birthday of this gigantic rift in Tertiary times " is denied and a " much younger origin " is announced, the evidence in favour of a long history going back into Tertiary times should be disproved.

Gregory recognised three main groups of faulting and, from the evidence available to him in 1921, placed these as: Oligocene (pre-Nyasan), Pliocene (or Naivashan), and Pleistocene. (The Rift Valleys and Geology of East Africa, page 216). His Naivashan group of faults were those which followed what he called the Laikipian Series in the volcanic succession. His Laikipian Series (although the name is perhaps an unhappy one, because more recent investigations have shown this series to be ill-represented in Laikipia) consisted of the older portion of the soda-rhyolites, pantellerites and pantelleritic

trachytes and the newer basic assemblage of volcanic rocks. This petrological group, extending to present-day volcanism in the Rift Valley, represents the extreme products of differentiation of the soda-rich magma which gave rise to the much older and relatively undifferentiated phonolites and Kenytes.

As far as I am aware, all the work of the Cambridge Archaeological Expedition, including that at Oldowai, the Kinangop Plateau and the Mau Escarpments, has been in areas profoundly affected by the Naivashan and post-Naivashan faulting and these groups of faulting alone in so far as formations exposed in those areas are concerned.

Clearly the recent palaeontological and archaeological work—and especially the association of dinotherium with human remains and artifacts in what appear to be pre-Naivashan, but post-Laikipian or perhaps in part intra-Laikipian, beds—necessitates a revision of the position of the Naivashan faulting in the geological time-scale. The age of this series of faults was placed by Gregory in the Upper Pliocene (The Rift Valleys and Geology of East Africa, 1921, pages 130, 205, and 216), chiefly because the assemblage of fossils from beds later than that group of faults, especially those from the Omo Valley, containing dinotherium, was not at that time regarded as later than Pliocene. It seems to me that recent palaeontological and archaeological work only indicates at most, as far as tectonics are concerned, that the age of this group faults and the change of configuration of the Rift Valley caused by it, should be raised from the Upper Pliocene to the Middle or Upper Pleistocene and does not in any way prove that the Rift Valley then had its birth, as appears to be contended by Dr. Reck.

Dr. Reck apparently recognises the existence of faulting prior to the Naivashan group; for on page 93 he speaks of an " older analogous structure." He seems, however, to regard this structure as a " broad and soft shaped trough." And again, on page 96 (referring to the Balbal depression), while holding that " . . . . throughout the time when Homo Sapiens lived in the Oldoway region . . . . there was no Rift Valley yet formed in the present sense of the word," he states that " . . . . the much older birth of its structure was sketched by the existence and growth of a parallel line of older volcanoes." Jaeger's work (1911 and 1913) showed that the Balbal and Eyasi depressions had a long history. Indeed one would think that Dr. Reck himself recognised a recent and localised character in the faulting of the Oldowai Sediments, for he indicates, on page 96, that it did not affect Lemagrut volcano, which stood in its path.

Nevertheless the youth of this group of faults is used as an argument to substantiate his views regarding the youth of the whole Rift Valley; for, referring to it and the peneplainisation of the

adjacent highlands, he observes on page 96 that " out of this relation the first proof of the unexpected youth of the Rift Valley could be deduced."

One gathers that Dr. Reck holds that peneplainised and, in general, mature surfaces characterise the highlands adjacent to the Rift Valley throughout its course from the Taurus Mountains to the south of Portuguese East Africa, for he observes on page 92: " Throughout the whole of this distance the general and unexceptional freshness of its forms is the contrasting character when compared with the succession of completed, mature forms of the surrounding country, and this is the sign of the absolute unison and unity of its age, its history and its existence."

He illustrates this by reference to the Nairobi District, and observes on page 91: " All around Nairobi mature forms characterise the highlands. The broad low backs of the mountains pass in gentle slopes down to equally broad shallow valleys . . . ." I assume that Dr. Reck refers to, or includes in this description, the Kikuyu Highlands between Nairobi and the eastern flank of the Rift Valley, where the Laikipian volcanic rocks which compose the region are cut by the Naivashan group of faults. I find it difficult to understand how that country can be described as mature. Both hydrologically and geologically it can, in my view, only be regarded as juvenile; for the streams are consequential on the dips of the lava flows and tuff beds, following roughly parallel courses and exhibiting few cases of river capture. This view was expressed by me in 1926 (The Stucture of the Eastern Flank of the Rift Valley near Nairobi, *Geogr. Journ.*, Nov., 1926) and more recent work bears it out. In fact neither on geological nor hydrological grounds does there appear any reason to assume a long interval between the last of the extrusions of Laikipian age and the commencement of the Naivashan group of faults. Certainly it is the case that the country south of Nairobi extending to the boundary with Tanganyika Territory is more mature, and in some cases when Archaean rocks occur, highly mature; but in this region the volcanic rocks, where they occur, are pre-Laikipian and the bounding faults of the Rift Valley are pre-Naivashan, though locally rejuvenated in some degree by Naivashan or post-Naivashan faulting.

Nor does it appear clear why Dr. Reck considers that the " broad and soft shaped trough " which he visualises as an " older analogous structure " should be regarded as " filled by the Kamasian Lake." Unless much of the highlands adjacent to the Rift Valley—highlands, which Dr. Reck regards as mature in type—or the floor of the Rift Valley or both, is postulated as having very different levels at that time to the extent of some thousands of feet, such a continuous lake could not exist. No doubt the products of the Laikipian volcanism blocked the Rift Valley at a number of places,

and isolated intra-Laikipian and post-Laikipian lakes were formed. The lake-basins would vary greatly in configuration and level as the Naivashan warping, tilting and foundering proceeded.

Except locally during volcanism and prior to the succeeding faulting, it is not apparent why the trough should be regarded as " broad and soft shaped " prior to the Naivashan faulting. In many places the pre-Naivashan faulting still exhibits prominent topographical features, as for instance the western flank of the Aberdares, Settima, Ngong, Doinyo Narok, el Kapiti and Ingito, the eastern flank of Nguruman and possibly Elgeyo. There seems no reason to think that these fault scarps were not originally as fresh and steep as the Naivashan fault scarps are now.

There is no intention in this note of attempting to assail in any way the most admirable and highly interesting palaeontological, archaeological, and geological work done by the Cambridge Archaeological Expedition and Dr. Reck. The only intention is to draw attention to various factors which may have been overlooked in making generalised deductions regarding the tectonic history of the Rift Valley.

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